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Risk Homeostasis and Corporate Acquisitions*

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Abstract

Adjustment of behavior to maintain risk, known as risk homeostasis, has previously been studied in a variety of psychological, health, social and economic contexts. This paper examines the evidence for risk homeostasis in corporate financial decisions involving mergers and acquisitions (M&As). We first show that when bidder corporations' risks decline relative to non-bidding peer firms prior to M&As, relative risk levels subsequently return to original levels. We argue this pattern is consistent with risk homeostasis whereby bidder companies have a target risk—that of their peers—and use M&As to regain this desired risk level after risk has declined. On the other hand, M&As are not used to reduce risk after it has increased. We develop a simple model of risk homeostasis in an acquisitions context, and find empirical support for our predictions: when a bidder's relative risk declines, the greater the risk of a target, the smaller is the investment in that target; and for a target firm smaller than the bidder, the larger the correlation between the target and the bidder returns, the smaller is investment in that target.

Keywords: Mergers and Acquisitions; Return Correlation; Risk Dynamics; Risk Homeostasis
JEL classification: G34

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I. Introduction

The investigation into the cause of the Challenger disaster, where the space shuttle exploded during takeoff in 1986 due to leakage of liquid helium, blamed the rubber seals on the fuel tanks—also known as O-rings.[1] These O-rings were designed to be flexible enough to allow them to expand to fill gaps at points of connection, particularly during the extreme turbulence of the launch. It appeared that the air temperature at the time of launch was too low for the O-rings' rated flexibility (the launch took place in January). The recommendation was that more flexible O-rings should have been used. However, it has been suggested that had more flexible O-rings been required, the lowest temperature at which launch would have been allowed would have been lower than it was, and the chance of such an event would not have been reduced.[2] In other words, the claim is that the risk NASA officials were taking would have remained the same, and the safety improvement from more flexible O-rings would have been offset by the lowered temperature threshold at which liftoff would be permitted.

The Challenger example above highlights the idea of behavioral adjustments to maintain risk, known as "risk homeostasis," (also known as "risk compensation") a concept generally attributed to Gerald J. S. Wilde (1994).[3] Applications of the concept are widespread, and frequently involve initial risk reductions and subsequent risk restorations, with the most discussed regarding the way people drive. For example, a study of traffic accidents compared taxi drivers who were provided with anti-skid braking systems (ABS) to those using conventional brakes, and found that accident rates were not reduced by this safety innovation.[4] It has been suggested, however, that this may not be because ABS is ineffective. Rather it is claimed that the lack of a safety increase from ABS use could be due to drivers with ABS offsetting the additional safety by engaging in riskier driving behavior. More generally, one might suspect that as drivers enjoy greater safety due to any of a large number of innovations or by choices of larger vehicles such as large SUVs, they are likely to take on greater risks of having accidents. Further examples of risk homeostasis are endless. Drivers will drive faster when protected by seat belts and air bags. Bicycle and ski helmets will reduce care taken against falling or colliding. Condoms will expand the range of sexual partners, reducing benefits otherwise promoted in the fight against AIDS and other STDs. Availability of bypass surgeries and cholesterol reducing drugs reduce incentives for maintaining a healthy diet. Aircraft more able to take off and land in stronger cross winds will be allowed to operate at higher wind speeds, conserving the accident rate; larger, more stable passenger ferries will be allowed to operate in rougher seas; and reduced chances of oil-well blowouts would lead to drilling in riskier underwater fields. More generally, engineering safety standards are specifically designed to ensure risk homeostasis by setting risk levels as targets to be achieved, for example, structures being able

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[1] See http://*history.msfc.nasa.gov/book/chptnine.pdf*.
[2] See Vaughan (1996).
[3] We thank Sheldon Cherry of the Faculty of Engineering, University of British Columbia, for bringing the early example of risk homeostasis in the Challenger example to our attention.
[4] See Burns and Wilde (1995).

to withstand one in an *n*-year event.[5] This paper applies the concept in corporate finance. Specifically, it examines how risk homeostasis, in the context of an exogenous decline in risk, is a factor among others that affects choices of targets when bidder firms are engaging in mergers and acquisitions (M&As).

Investigation of risk homeostasis in the M&A setting is motivated by the observation that bidders, whose risks happen to have declined relative to their industry peers of similar size prior to a takeover bid—the focus of our study—show a return to their initial risk levels after completing a deal. That is, bidder firm risk versus peer firm risk, measured in terms of the difference in standard deviations of stock returns, shows a distinct V-shape over the period surrounding an acquisition: declining beforehand and then subsequently returning to its initial level.[6] For risk-declining bidders the difference in relative risk—the peer firm risk minus the bidder risk—is at its maximum at the time the acquisition bid is made. We argue that this is consistent with declines in relative risk of bidders (versus their peers) *ceteris paribus* increasing the risk they are willing to take on through M&A activities.[7] On the other hand, M&As do not appear to be used to reduce risk after it has increased relative to the risk of peers. One might argue that such asymmetry between the effect of risk decreases versus risk increases is reasonable if M&As are intrinsically risky activities, given the nature of these often complex events. The posited behavior is supported by testing the implications of a model in which bidder firms take into account their relative risk objectives when choosing takeover targets.

It should be emphasized that we are not suggesting restoring risk after it declines is the only motive for acquisitions and mergers. We are also not suggesting restoring risk is critical for the choice of targets which could involve all the conventional factors that have been and are being suggested in the vast and growing M&A literature (see the survey by Betton, Eckbo, and Thorburn (2008)). What we propose in this paper is that restoration of risk is a factor, among others, that can play a role in the selection of targets after an incidental decline in firm risk when the bidder has already chosen to go on the M&A trail.

The presence of a target is not without parallel in corporate finance. For example, the idea that companies have a target capital structure, leading to compensatory behavior when the target ratio of debt to equity is significantly disturbed, is an element of orthodoxy in financial discourse.[8] Indeed, the choice of capital structure relates closely to insolvency risk. Targets are also discussed in the context of corporate dividend policy.[9] Furthermore, such targets can coexist: they are by no means mutually exclusive. In the same vein, the risk homeostasis considered here can coexist with other corporate policy targets.

[5] Note that risk homeostasis differs from moral hazard in that this behavior does not necessarily harm others. Of course, in cases where others are adversely affected there is an element of moral hazard that goes along with taking extra risk.
[6] This pattern has been documented in the context of M&As by Hackbarth and Morellec (2008) who focus on the behavior of stock returns in takeovers from a value-maximizing real options perspective. A potentially related pattern in the context of seasoned equity offerings has been shown by Carlson, Fisher, and Giammarino (2010).
[7] The decline in risk could be entirely exogenous, unlike the exercise of growth options examined by Hackbarth and Morellec (2008) and Carlson et al. (2010).
[8] See recent evidence on the existence of target capital structure in Hovakimian, Opler, and Titman (2001), Hovakimian, Hovakimian, and Tehranian (2004), and Harford, Klasa, and Walcott (2009).
[9] Starting from the seminal work on a target dividend policy by Lintner (1956), there is ample evidence on the existence of a target when firms make their payout decisions (see recent work by Grullon and Michaely (2002) and the survey by Allen and Michaely (2003)).

In order to identify the implications of risk homeostasis a simple model is constructed. The model predicts that, *ceteris paribus*, the relative size of a takeover target vis-à-vis its bidder will be lower the higher is the risk of the target: a smaller acquisition will restore bidder firm risk after it has declined the riskier is the acquisition. The model also predicts that for an acquisition where the target firm happens to be smaller than the bidder, the relative size of a target vis-à-vis its bidder is lower the higher is the correlation between the target and the bidder stock returns: risk restoration can be achieved with a smaller acquisition the higher the return correlation. These model predictions are supported by our empirical investigation of a sample of M&As over the period 1980-2007, where we also consider other conventional influences on takeover decisions in order to distinguish the effects of risk homeostasis from alternative explanations.

The paper proceeds as follows. In Section II we describe the data and show the patterns of the relative risk of the bidders surrounding M&A events that motivates our study. The asymmetry in responses to relative risk declines versus increases is evident in these patterns. In Section III we introduce a simple model of risk homeostasis and develop its implications for the characteristics of bidder and target firms. The implications of our model are tested and supported in Section IV. We consider other possible explanations, including a simple model of risk aversion, for the V-shaped pattern of bidder relative risk after risk declines. Regression results are presented in Section V. We conclude in Section VI.

II. Risk Dynamics Surrounding M&As

We start with acquisition bids targeting U.S. companies between January 1, 1980 and December 31, 2007 covered by the Thomson's SDC database. We limit the deal form to merger (SDC deal form "M"), acquisition of majority interest ("AM"), or acquisition of assets ("AA"). There are 172,701 such deals, among which 136,588 are completed. Our analysis focuses on these completed deals.

At the fiscal year end before a bid announcement, each bidder is matched with a Fama-French (1997) 48-industry peer with the closest size as measured by total assets, retrieved from the Compustat database. Industry peers that have completed any major M&A deals (i.e., the ratio of the target size to the bidder size is greater than 5% and the bid is associated with change of control) during months [–36, +36] around the bid announcement date are excluded from the pool of potential matches. We are able to find matching firms for bidders in 48,632 merger deals. For both the bidder and its match, we measure risk in terms of the annualized standard deviation of daily returns within a calendar month. Specifically, following Schwert (1989) and Carlson et al. (2010), we divide our sample into 21 trading-day periods ("event months") prior to the announcement (excluding the announcement date) and after the completion of the takeover (excluding the effective date). We consider as a single period ("event month zero") the interval between one day after the announcement date and one day before the effective date, regardless of how long that interval is.[10] As a result, every event month corresponds to 21 trading days except for event month zero. We do

[10] We exclude both the announcement day and the effective day of the takeover in our calculation of risk to eliminate the effect of market reaction to a major corporate event. Note that excluding 3-days or 5-days after (before) the announcement (effective) day for event month zero does not change our main findings.

this for each of the 36 event months both before the bid announcement date and after the effective date.

To explore the effect of risk homeostasis we first define the relative change in firm risk as the difference between the change in bidder risk from one month prior to the bid announcement to thirty-six months prior, and the change in risk of the bidder peer firm over the same period. We then focus on bidders with declining relative risk in the pre-bid period, and plot the risk dynamics surrounding M&As. Our final sample has 696,812 firm-month observations involving 10,824 unique acquisition deals where the bidder's relative risk declines over the three-year period leading up to the bid announcement.[11]

The rationale for considering bidder risk relative to industry-peer risk is based on the notion that in choosing corporate strategies, it is safer for management to follow similar paths to those of firms against which they are widely compared by boards and shareholders than to select an idiosyncratic corporate strategy. This is because the cost of going alone with a strategy and failing is higher than the benefit of going alone and succeeding. Making the right choice with others will bring some praise and possibly tangible benefits. Making the wrong choice with others will not please boards and shareholders, but the consequences should be softened through the justification that other firms did the same. Success with an idiosyncratic choice will certainly bring managers more praise and reward than success with the common strategy. However, the cost of selecting a failing strategy when being alone in that choice is likely to be far greater than the benefit of success while going alone. "Your peers made the right choice. Why didn't you see what they could see?" This should apply to the risk taken on by corporate managers as it applies to portfolio choices made by mutual fund managers or earnings forecasts made by financial analysts: there is pressure to revert toward the norm (see, for example, Wermers (1999), and Hong, Kubik, and Solomon (2000)).

Figure 1 plots the mean and median differences in firm risk between the bidder and its matching firm. In this graph, the value of zero on the horizontal axis corresponds to the announcement date. All negative numbers are event months prior to the announcement date. All positive numbers are event months after the effective date. Event month zero is the period ranging from the day after the announcement date to the day before the effective date irrespective of the actual elapsed time. The mean (median) length of event month zero is 80 (59) trading days.[12] The vertical axis corresponds to the mean/median difference in risks between the bidders and their matching firms, expressed in real numbers. We see that the risks of the bidders with declining risk relative to their industry peers exhibit a gradual decline from the 36th month before the acquisition bid, reaching the bottom at the time of the bid. Then the risks of the bidders, relative to their industry peers, return toward the pre-bid levels by the 36th month after the completion of the transaction. There is a pronounced V-shape in the risk dynamics of bidder firms surrounding the takeover event.[13]

[11] In unreported analysis, we find that the magnitude of increases in risk among bidding firms is only a fraction of the magnitude of decreases in risk among our sample firms prior to M&As.

[12] We exclude firm-month observations for which event month zero has less than 10 trading days because the firm risk measure may be problematic due to fewer observations. In untabulated analysis we find that the V-shape is even more distinct if we do not impose any data requirement for event month zero.

[13] In untabulated analysis, we show that using the annualized standard deviation of residuals from a market model gives a similar V-shaped pattern. Unlike the findings in Hackbarth and Morellec (2008), there is no distinct V-shaped pattern

As we noted earlier, the concept of risk homeostasis has been widely applied outside the field of finance where it predominantly involves reaction to exogenous declines in risk as in the construction of Figure 1. Figure 2 examines whether there is asymmetry in the dynamic patterns of risk after increases in risk versus declining risk. We find that, in the case of M&As, risk restoration is not present when bidder firms have experienced risk increases relative to their peers. This is suggestive of the fact that bidding for an acquisition is not a preferred path for reducing risk.

It might be argued that the V-shaped risk observed in Figure 1 is the result of Black's (1976) leverage effect: M&As tend to take place following rising bidder stock prices which are associated with reduced leverage and therefore declining bidder risk. If this line of argument is correct we would expect that prior to an acquisition bid, targets which experience stock price declines and hence increasing leverage would have increasing volatility. In Figure 3 we show that this is not the case. More generally, there is no distinct V-shape pattern in the sample of target firms. Also, later in our multivariate analysis we explicitly control for leverage in the model specification and yet our predictions based on risk homeostasis are upheld.

In the following section we develop a simple model to examine the implications of risk homeostasis in M&As and to compare predictions from alternative perspectives such as risk aversion.

III. Risk Homeostasis: *Ceteris Paribus* Implications for M&As

Let us consider the value of a merged firm whose value comes from both the bidder and the target firms. Specifically, the bidder decides how to divide its (combined) market value, V, between its current operations worth x (the bidder value before the merger) and an acquisition target costing y. Let the proportion of its pre-merger value, x, invested into the target firm be λ. After the takeover the combined firm value can be written as:[14]

$$V = (1-\lambda)x + \lambda y. \qquad (1)$$

For the purpose of determining the effect of exogenous changes in bidder risk for the choice of target as implied by risk homeostasis we ignore possible merger gains or losses. In summary:

V = Bidder value after acquisition

x = Bidder value before acquisition

y = Normalized target value before acquisition

λ = Proportion invested in the target

From Equation (1), we can compute the variance of the combined firm as:

$$\sigma_V^2 = (1-\lambda)^2\sigma_X^2 + \lambda^2\sigma_Y^2 + 2\lambda(1-\lambda)\sigma_{XY}. \qquad (2)$$

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for the measure of systematic risk. Further, the V-shaped pattern is robust to accounting for microstructure issues by filtering out first-order return autocorrelations as in Andersen, Bollerslev, Diebold, and Ebens (2001).

[14] The measure of target value y is normalized to the size of x. We can think of a scaling factor adjusting the dollar value of y where this factor is lost under differentiation.

Our goal is to determine the implications of an exogenous decrease in bidder risk, i.e., $\frac{\partial \sigma_X^2}{\partial t} < 0$, for the amount invested in the target, $\frac{\partial \lambda}{\partial t}$, when there is risk homeostasis, i.e., $\frac{\partial \sigma_V^2}{\partial t} = 0.$ That is, we want to evaluate $\frac{\partial \lambda / \partial t}{\partial \sigma_X^2 / \partial t}$ when $\frac{\partial \sigma_V^2}{\partial t} = 0.$ For simplicity we assume an absolute risk target rather than a relative target.

From Equation (2),

$$d\sigma_V{}^2 = (1-\lambda)^2 \frac{\partial \sigma_X^2}{\partial t} dt + \sigma_X^2 \frac{\partial (1-\lambda)^2}{\partial t} dt + \lambda^2 \frac{\partial \sigma_Y^2}{\partial t} dt + \sigma_Y^2 \frac{\partial \lambda^2}{\partial t} dt + 2\lambda \frac{\partial \sigma_{XY}}{\partial t} dt + 2\sigma_{XY} \frac{\partial \lambda}{\partial t} dt$$
$$- 2\lambda^2 \frac{\partial \sigma_{XY}}{\partial t} dt - 2\sigma_{XY} \frac{\partial \lambda^2}{\partial t} dt$$
$$= 0,$$

when there is risk homeostasis.

Assume $\frac{\partial \sigma_Y^2}{\partial t} = \frac{\partial \sigma_{XY}}{\partial t} = 0$, i.e., the risk of the target and the covariance between the target and the bidder returns are not changing: we are seeking how exogenous variations in the bidder risk, *ceteris paribus*, affect takeovers. Then the expression above becomes:

$$(1-\lambda)^2 \frac{\partial \sigma_X^2}{\partial t} - 2(1-\lambda)\sigma_X^2 \frac{\partial \lambda}{\partial t} + 2\lambda \sigma_Y^2 \frac{\partial \lambda}{\partial t} + 2(1-2\lambda)\sigma_{XY} \frac{\partial \lambda}{\partial t} = 0.$$

That is,

$$(1-\lambda)^2 \frac{\partial \sigma_X^2}{\partial t} = 2\left\{(1-\lambda)\sigma_X^2 - \lambda \sigma_Y^2 - (1-2\lambda)\sigma_{XY}\right\} \frac{\partial \lambda}{\partial t}.$$

Thus,

$$\frac{\partial \lambda / \partial t}{\partial \sigma_X^2 / \partial t} = -\frac{(1-\lambda)^2}{2[\lambda \sigma_Y^2 - (1-\lambda)\sigma_X^2 + (1-2\lambda)\sigma_{XY}]}. \qquad (3)$$

From Equation (3), we can derive the effects of the target risk, σ_Y^2, and the covariance between the target and the bidder, σ_{XY}, on the proportion of *x* moved into *y*. Taking the partial derivative of the bidder's investment in target λ with respect to the target risk σ_Y^2, yields[15]

[15] Recall that $(\partial \sigma_X^2 / \partial t)$ is negative: we are considering implications of risk homeostasis when there has been a decline in the bidder's relative risk.

$$\frac{\partial(\partial\lambda/\partial t)}{\partial\sigma_Y^2} = \frac{\lambda(1-\lambda)^2 \times (\partial\sigma_X^2/\partial t)}{2[\lambda\sigma_Y^2 - (1-\lambda)\sigma_X^2 + (1-2\lambda)\sigma_{XY}]^2} < 0. \quad (4)$$

The higher is the target risk, the smaller is the proportion of *x* moved into the target firm in response to an exogenous decline in bidder risk: a riskier target means less investment in the target is needed to restore the bidder risk.

Similarly, we have:

$$\frac{\partial(\partial\lambda/\partial t)}{\partial\sigma_{XY}} = (1-2\lambda)\frac{(1-\lambda)^2 \times (\partial\sigma_X^2/\partial t)}{2[\lambda\sigma_Y^2 - (1-\lambda)\sigma_X^2 + (1-2\lambda)\sigma_{XY}]^2} \begin{cases} < 0 \; if \; \lambda < 0.5 \\ > 0 \; if \; \lambda > 0.5 \\ = 0 \; if \; \lambda = 0.5 \end{cases}. \quad (5)$$

The value and even the sign of the effect of the covariance on λ is seen to depend on the magnitude of λ. In particular, there is bifurcation around $\lambda = 0.5$ such that when $\lambda < 0.5$, the larger is the covariance between the target and the bidder stock returns, the *less* investment is made in *y* in response to a decline in bidder risk. On the other hand, when $\lambda > 0.5$, the larger is the covariance between the target and the bidder stock returns, the *more* investment is made in *y* in response to a decline in bidder risk. At $\lambda = 0.5$ there is no effect of covariance on λ. The reason for this prediction of risk homeostasis, which helps distinguish it from an alternative M&A model based on risk aversion (to be discussed later), is most easily seen when considering Equation (2).

In Equation (2), when there is a decline in σ_X^2, in order for σ_V^2 to remain unchanged via covariance we need an appropriate offsetting adjustment in $2\lambda(1-\lambda)\sigma_{XY}$. Note that the smaller is σ_{XY}, the larger must be $2\lambda(1-\lambda)$ to maintain the value of σ_V^2. Note also that the value of $2\lambda(1-\lambda)$ is at its maximum at $\lambda = 0.5$ and diminishes as λ decreases or increases. In other words, λ must move toward 0.5 when σ_{XY} decreases. Hence when $\lambda < 0.5$, the smaller is σ_{XY} the larger is the amount invested in *y* (that is, λ), while when $\lambda > 0.5$ the smaller is σ_{XY} the smaller is λ. Since covariance is symmetrical with respect to *x* and *y*, at $\lambda = 0.5$, where the value of $2\lambda(1-\lambda)$ is at its maximum, the covariance makes no difference.

In summary, our predictions of risk homeostasis in M&As are:[16]

1. The higher is the target risk, the less is invested in the target by the bidder.
2. Contingent on the target firm being smaller than the bidder, i.e., $\lambda < 0.5$, the larger is the covariance between the target and the bidder returns, the less is invested in the target. On the other hand, when the target firm is larger than the bidder, i.e., $\lambda > 0.5$, the larger is the

[16] In the M&A literature there is one other paper that we are aware of that examines the return correlation between the bidder and the target firm. Officer (2004) shows that one important determinant of the bid structure (cash, stock, and whether a collar is used) is the return correlation between the bidder and the target returns.

covariance between the target and the bidder returns, the more is invested in the target. More generally, to allow for the effect of λ—including the bifurcation—it is necessary to multiply the covariance between the target and the bidder returns by $(1-2\lambda)$ when evaluating its effect.[17]

In the sections that follow, we first empirically evaluate the above predictions from the risk homeostasis model in a multivariate context; we then consider an alternative model with risk aversion in M&As and test its implications.

IV. Testing Implications of Risk Homeostasis

To test the predictions from our simple M&A model of risk homeostasis, we form our sample using the following criteria. First, both the bidder and target firms must be public so that we can compute firm risk using stock returns. Second, we limit the deal form in the SDC database to merger (SDC deal form "M"), acquisition of majority interest ("AM"), or acquisition of assets ("AA"). Third, the bidder must experience relative risk decline before an M&A. Finally, all the key variables for our multivariate analysis must be available. The final sample has 1,093 deals. Our model provides predictions about the relation between the relative size of an acquisition deal and the target risk, and the covariance between the target and the bidder returns. For simplicity and to highlight the main implications, the model is cast in terms of *levels* of risk and covariance. However, the variable of interest, relative size—defined as the ratio of the target size to the bidder size—is dimensionless. Therefore in the empirical test of our model, we relate relative size to explanatory variables that are also dimensionless. Relative risk—computed as the ratio of the risk of the target to that of the bidder—is dimensionless. Further, rather than using the covariance between the target and the bidder returns, we instead use the correlation.

We compute relative risk and correlation of returns using daily returns over days [−425, −60] before the bid announcement date. The reason for the two month gap between the last day of our estimation window and the bid announcement date is to reduce the possibility of information leakage that might contaminate our estimation results (Betton, Eckbo, and Thorburn (2009)).

Table 1 presents summary statistics of our sample firms. The abnormal announcement period returns (CAR3) are over days [−1, +1], where day 0 is the bid announcement date. Daily abnormal stock returns are computed using the market model and the value-weighted CRSP index. The estimation window is days [−452, −60] prior to the announcement date. We show that the average (median) CAR3 for the bidder is −1.2% (−1.1%), while the average (median) CAR3 for the target is 20.3% (16.1%). These descriptive statistics suggest that our sample is not much different from the population of M&As between public firms examined in Betton, Eckbo, and Thorburn (2008).

The sample mean (median) relative size is 19.2% (5.8%). The sample mean (median) relative risk is 1.625 (1.406). Bidders tend to have lower risk than their target firms, as we would expect if the choice of targets includes restoring bidder firm risk to its previously higher level. The

[17] As Equations (4) and (5) make clear, λ plays a more complex role on the size of the effects of bidder risk and covariance between the target and the bidder returns on investment in the target.

sample mean (median) correlation is 0.138 (0.102). Other firm and bid characteristics are similar to other M&A studies.

Table 2 presents the correlation matrix. We show that relative size is negatively and significantly associated with relative risk. Relative size is negatively and significantly associated with the adjusted correlation between the target and the bidder returns. Overall, the extent of correlation among most pairs of variables raises little concern for multicollinearity in our regression analysis. Given that omitted variable bias in univariate correlations can mask the true relations between the variables, next we employ multiple regressions to examine the determinants of relative size based on our risk homeostasis model.

Table 3 presents our main test results. Column (1) examines the role of relative risk and correlation between the target and the bidder returns multiplied by $(1-2\lambda)$ as predicted by our model, without additional controls. Consistent with our model's first prediction, we show that relative risk is negatively associated with relative size, and is significant at the 1% level. That is, the greater is the risk of a target firm relative to its bidder, the smaller is the investment in that target. Put differently, a smaller acquisition investment is sufficient to restore bidder risk the riskier is that investment.

Consistent with our model's second prediction, we find that the coefficient on the product of return correlation and $(1-2\lambda)$ is negative and significant at the 1% level. That is, conditional on the target firm being smaller than the bidder, the larger is the correlation between the target and the bidder, the less is invested in the target: high correlation restores risk more effectively than does low correlation. It should be noted, however, that in order to incorporate the conditioning effect of λ as predicted by the model, λ appears on both sides of the regression: unavoidably, the size of the acquisition affects the importance and even the direction of the effect of the correlation of the target and the bidder returns. The λ on the right hand side is, however, modified by the return correlation, with the simple correlation of $(1-2\lambda)\sigma_{XY}$ and λ being only –0.52 (see Table 2).

In Column (2), we add other firm and deal characteristics that might explain the cross sectional variation in relative size. We find that relative risk and return correlation remain negatively associated with relative size, and both are significant at the 1% level. Further, we show that bidders with poor operating performance, and deals whose method of payment is exclusively cash, tend to be associated with smaller acquisitions. We also see that bidders that have experienced higher stock price runups tend to be pursuing larger deals.

We conclude that both the relative risk dynamics of bidder firms and the multivariate regression results are consistent with risk homeostasis in M&As after declines in relative risk. This has potentially broader implications than the presence of just another target beyond capital structure and dividend policy to consider in corporate finance. While some of the possible settings of risk homeostasis mentioned in the introduction have been studied, such as taxis with and without ABS and the effect of structural engineering safety standards, many possible settings, including key questions in finance, have not. Data availability makes M&As a good place to start. Behaviors of economic agents and other possible contexts of risk homeostasis mentioned in the introduction, may be very fertile areas to study next. Questions addressed may include the matters of symmetry versus asymmetry, and whether homeostasis occurs in absolute or relative form.

V. Alternative Interpretations and Additional Investigation

In this section we first consider our risk homeostasis perspective of M&As in the context of prior work and examine the robustness of our findings. We then introduce a simple alternative model with risk reversion and test its implications.

Relation to Prior Work

Risk homeostasis has not previously been discussed in a corporate finance context, and offers a new window on what has been learned about the dynamics of returns around M&As in a developing literature. Hackbarth and Morellec (2008) employ a real options framework to provide an explanation of why and when mergers take place. Specifically, their prediction on the temporal evolution of bidder beta surrounding the takeover is contingent upon the relative risk of the bidder versus its target. When bidder beta is greater than target beta, the shape of the beta time series is V; otherwise, the shape is an inverted-V. In contrast, under our risk homeostasis hypothesis of M&As, decisions are made in the context of bidders' objectives, *ceteris paribus,* in restoring a similar level of risk as their industry peers after it declines.

Carlson et al. (2010) examine both theoretically and empirically firm-level systematic risk (as measured by beta); not around M&As, but rather around seasoned equity offerings (SEOs). They show that beta increases before SEOs and decreases gradually thereafter, and they interpret the observed phenomenon (an inverted V-shape) to be consistent with a real options framework of SEOs. Further, they show that firm risk—measured in the same way as in Schwert (1989) and our paper—exhibits a V-shape. They interpret the above pattern as "volatility timing"—SEO firms time their issue event at the bottom of firm and market-wide volatility.

Shleifer and Vishny (2003) develop a model in which irrational shifts in investor sentiment affect takeover decisions. Their market timing hypothesis posits that market inefficiency has important effects on takeover activity: bidders profit by buying undervalued targets for cash at a price below fundamental value, or by paying equity for targets that, even if overvalued, are less overvalued than the bidders' equity. However, there is no clear prediction on the time series pattern of bidder risk relative to its peers in the period surrounding the takeover. To control for the extent of market timing we include both the bidder price run-up and the overall market run-up leading to the takeover (see Column (2) of Table 3). The key predictions of our model are still supported by the data.

Harford, Klasa, and Walcott (2009) show that deviations from target capital structure affect bidders' acquisition strategies. Specifically, when a bidder's leverage is over its target level, it is less likely to finance the acquisition with debt and more likely to finance the acquisition with equity. In our particular context where we try to explain cross-sectional variations in relative size, we would expect that a bidder's deviation from its target could potentially affect the size of the target acquired. To control for leverage targeting, in Column (3) of Table 3 we replace bidder leverage by a measure of the pre-acquisition leverage deviation of the bidder firm computed in the same way as Harford et al. (2009). Our model predictions are still supported. Further, we find that there is no significant association between leverage targeting and the choice of target size.[18]

Coles, Daniel, and Naveen (2006) find that CEOs whose compensation packages are more sensitive to stock volatility take on more risk as measured by larger investment in R&D, lower capital expenditures, fewer segments, and higher leverage. To control for managerial incentives, in Columns (4) and (5) of Table 3 we include bidder top executives' pay-to-performance sensitivity and their pay-to-risk sensitivity, respectively, to our basic specification in Column (2).[19] Our model predictions are still supported. Further, we find that none of the executive incentive measures is significantly associated with relative size.

Cheng (2008) shows that board size is negatively associated with the variability of monthly stock returns. He interprets his finding as supporting the view that it takes more compromises for a larger board to reach consensus, and consequently, decisions of larger boards are less extreme, leading to less variable corporate performance. Following Cheng (2008), in Column (6) of Table 3 we include measures of bidder board governance: board size, board independence, and bidder CEO being Chairman of the Board (COB). We find that our model predictions are supported by the data, while none of the board governance measures is significantly associated with relative size. Column (7) has the encompassing specification. Our model predictions remain.

Implications from An Alternative M&A Model Based on Risk Aversion

It is natural to ask the question as to whether the robust effects we have found of target risk and correlation between target and bidder returns on the relative size is due to bidder risk aversion rather than to risk homeostasis. To explore that further, we consider a simple M&A model based on risk aversion.

Suppose the bidder is risk averse and therefore tries to minimize the risk of the combined firm as given in Equation (2). Taking the partial derivative of the combined firm risk with respect to the relative size λ and setting it to zero, yields:[20]

$$2(\sigma_X^2 + \sigma_Y^2 - 2\sigma_{XY})\lambda^* + 2(\sigma_{XY} - \sigma_X^2) = 0,$$

or

$$\lambda^* = \frac{\sigma_X^2 - \sigma_{XY}}{\sigma_X^2 + \sigma_Y^2 - 2\sigma_{XY}}. \qquad (6)$$

Parallel to our analysis under risk homeostasis, we are interested in how the target risk σ_Y^2 and the covariance between the target and the bidder returns σ_{XY} affects the optimal level of relative size λ^* such that risk is minimized as suggested by risk aversion.

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[18] It can be argued that bidders tend to have experienced strong performance, leading to reduced leverage, both known to be related to M&As. We note that after controlling for both prior performance and deviation of leverage from a target level, our model predictions are still supported by the data.

[19] We do not include both pay-for-performance sensitivity and pay-for-risk sensitivity in the same regression to mitigate the problem of multicollinearity: the correlation coefficient between them is 0.83.

[20] Note that the second-order derivative of the combined firm risk w.r.t. λ is non-negative, suggesting that there is an optimal level of λ^* at which firm risk is minimized.

Taking the partial derivative of the bidder's optimal investment in target λ^* with respect to the target risk σ_Y^2 yields:

$$\frac{\partial \lambda^*}{\partial \sigma_Y^2} = -\frac{\lambda^*}{\sigma_X^2 + \sigma_Y^2 - 2\sigma_{XY}} \leq 0. \tag{7}$$

The higher is the target risk, the smaller is the proportion of *x* moved into the target firm in order to minimize risk—the same prediction as that from our risk homeostasis model. On the other hand, taking the partial derivative of the bidder's optimal investment in target λ^* with respect to the covariance between the target and bidder returns, σ_{XY}, yields:

$$\frac{\partial \lambda^*}{\partial \sigma_{XY}} = \frac{\sigma_X^2 - \sigma_Y^2}{(\sigma_X^2 + \sigma_Y^2 - 2\sigma_{XY})^2}. \tag{8}$$

In general, high correlation adds risk to the bidder from acquiring a target firm, *ceteris paribus*, reducing the relative size. Equation (8) shows that the sign of the effect of the return covariance on the optimal level of investment in the target firm also depends on the magnitude of the target risk σ_Y^2 vis-à-vis the bidder risk σ_X^2. If the target firm is more risky than the bidder, the bidder will invest less in the target when the returns of these two firms move together. On the other hand, if the target firm is less risky than the bidder, the bidder will invest more in the target if the returns of these two firms move together. This is because the goal of the bidder is to minimize the total risk of the combined firm. The above predictions are distinctly different from the risk homeostasis model.

In summary, the predictions of our simple risk aversion model in M&As are:

1. The higher is the target risk, the less is invested in the target by the bidder.
2. Contingent on the target risk being greater than the bidder risk, there is a negative relation between the return covariance and the relative size; otherwise, there is a positive relation between the return covariance and the relative size.

To test the validity of this simple risk aversion model, we separate our M&A sample into two subsamples: one where the target risk is greater than the bidder risk, and the other where the target risk is smaller than the bidder risk. Table 4 presents the results.

Table 4 Panel A shows that when the target risk is greater than the bidder risk, there is a negative and significant association between the target risk and the relative size; this is consistent with the prediction from both the risk homeostasis and risk aversion models. However, there is a positive and significant association between the return covariance and the relative size, contrary to the prediction based on risk aversion. Table 4 Panel B shows that when the target risk is smaller than the bidder risk, there remains a negative association between the target risk and the relative size (though not statistically significant). There is mixed evidence regarding the relation between the return covariance and the relative size under risk aversion; this is in contrast to the consistently supportive evidence for the risk homeostasis model. The results from Table 4 complement the conclusion reached by examining the risk dynamics. If risk aversion were influencing choices of target firms, the bidder risk dynamics after the deal completion would not complete the V shape that we observe, but would rather stay as a horizontal line.

VI. Conclusions

It is so customary in finance to base behavior on risk aversion that it is easy to overlook the possibility that in some contexts managers may, alongside value creation and other objectives when pursuing M&As, want to remain in a preferred comfort zone of relative risk. Corporate decision-makers may feel more at ease with their firm risks being comparable to their peers against whom they are being assessed than otherwise, and if they find relative risk declining, they may include risk preservation among other factors when pursuing M&As. We are interested in how such a goal may be achieved through choices of target firms and the implications of pursuing such a goal. These implications are based on a simple model of risk homeostasis, and investigated with a regression model that includes the usual set of control variables that influences the choice of targets.

We have also found that M&As do not appear to be used as a means of restoring risk when it has been increasing. That is, there is asymmetry between the dynamics around risk declines and risk increases. This finding is consistent with the view that M&As are intrinsically risky, and the notion that there are better alternative ways of reducing risk such a adjustments in capital structure and/or day-to-day operations. This aspect of our findings clearly requires further research, including investigation of the symmetry/asymmetry in other risk contexts.

The motivation for our investigation comes from the observation that bidder firms whose risks decline relative to industry peers experience declines during the 36-month period prior to a takeover. Relative risks return towards original levels in the subsequent 36 months. Our simple model of risk homeostasis predicts that the riskier is a target firm, the smaller will be the target size relative to the bidder size; and that for a target firm that is smaller than its bidder, the higher is the covariability between the target and the bidder stock returns, the smaller is the target size relative to the bidder size. Multivariate regression analysis of relative size against relative risk and return correlation between the target and the bidder confirms predictions from our risk homeostasis model, while rejecting key predictions from an alternative risk aversion model. All the evidence is consistent with bidders, *ceteris paribus*, exhibiting risk restoration towards the risk of industry peers, but only after experiencing relative risk declines.

This paper is the first to consider risk homeostasis, an established principle in psychology, in a financial context, specifically in the area of corporate decision making. M&As, which have been closely examined by both theoreticians and empiricists, are a relatively easy place to begin. We believe that the support for risk homeostasis found in this paper suggests further study of this phenomenon, in other areas of finance, economics, and in other social sciences. What we learn could have important implications for policy. We ignore this phenomenon at our own risk.

Appendix:
Variable Definition

Variables	Definition
Bidder/Target CAR3	The abnormal announcement period returns (CAR3) are over days [−1, +1], where day 0 is the bid announcement date. Daily abnormal stock returns are computed using the market model and the value-weighted CRSP index. The estimation window is days [–425, –60] prior to the bid announcement date.
Relative Size	The transaction value divided by the market value of total assets of the bidder at the fiscal year end prior to the bid announcement date. Market value of assets is book value of total assets (data 6 in the CRSP-Compustat merged database) minus book value of common equity (data 60) plus common shares outstanding (data 25) times stock price (data 199).
Bidder Risk	The annualized standard deviation of the daily stock returns of the bidder during days [−425, −60] prior to the bid announcement.
Target Risk	The annualized standard deviation of the daily stock returns of the target during days [−425, −60] prior to the bid announcement.
Relative Risk	The ratio of the target risk to the bidder risk, where risk is computed as the annualized standard deviation of the daily stock returns during days [−425, −60] prior to the bid announcement date.
Return Correlation	The correlation of the bidder's and target's daily stock returns during days [−425, −60] prior to the bid announcement date.
Bidder Sales Growth	The ratio of sales (data 12) in the current fiscal year to sales in the last year minus 1.
Bidder ROA	Income before extraordinary items (data 18) divided by the book value of total assets (data 6) at the beginning of the fiscal year.
Bidder Book Leverage	The sum of debt in current liabilities (data 34) plus long-term liabilities (data 9) divided by the book value of total assets (data 6).
Bidder Book Leverage Deviation	Following Harford, Klasa, and Walcott (2009), we run a tobit regression of firm book leverage on a set of explanatory variables for all firms in the Compustat database for each year from 1979-2007. Leverage deviation is the difference between the actual book leverage and the predicted leverage from the tobit regression. The explanatory variables include lagged return on assets (data 18), logarithm of sales (data 12), PPE (data 30) scaled by total assets (data 6), market-to-book asset ratio, R&D (data 46) scaled by sales (data12), an indicator variable for missing R&D, selling expenses (data 45) scaled by sales (data 12), and the Fama-French 48 industry fixed effects.
Tender Offer	An indicator variable that takes the value of one if the bid is regarded as a tender offer by the SDC database, and zero otherwise.
Competing Bids	An indicator variable that takes the value of one if the number of bidders is larger than one, and zero otherwise.

All Cash	An indicator variable that takes the value of one if only cash is used to pay for the acquisition, and zero otherwise.
All Stock	An indicator variable that takes the value of one if only stock is used to pay for the acquisition, and zero otherwise.
Diversifying	An indicator variable that takes the value of one if the bidder and its target are in the same Fama-French industry, and zero otherwise.
Bidder Price Runup	The cumulative returns during the one-year period ending on day −2 prior to the bid announcement date.
Market Price Runup	The cumulative market returns during the one-year period ending on day −2 prior to the bid announcement date.
Bidder Delta	Logarithm of changes in the bidder top executives' compensation for a 1% change in the bidder's stock price.
Bidder Vega	Logarithm of changes in the bidder top executives' compensation for a 0.01 change in the standard deviation of the bidder's stock returns.
Bidder Board Size	The number of directors serving on the bidder board.
Bidder Board Independence	The number of independent directors divided by the board size.
Bidder CEO is COB	An indicator variable that takes the value of one if the bidder CEO is also the Chairman of the Board (COB), and zero otherwise.

Figure 1
Relative Risk Dynamics: The Bidder Firms with Declining Relative Risk before M&A

This figure plots the time series of mean and median differences in firm risk between bidders and their industry- and size-matched control firms, for the 36 months before the bid announcement date and the 36 months after the deal effective date. Month 0 starts from the day after the bid announcement and ends on the day before the deal effective date. All other months consist of 21 trading days. Firm risk is the annualized standard deviation of the daily stock returns in the month. At the fiscal year end before bid announcement, each bidder is matched with a Fama-French (1997) 48-industry peer with the closest size. Only bidders with *negative* relative change in firm risk from month –36 to –1 are included. Relative change in firm risk is defined as (bidder risk in month –1 – bidder risk in month –36) – (match firm risk in month –1 – match firm risk in month –36). The sample has 696,812 firm-month observations.

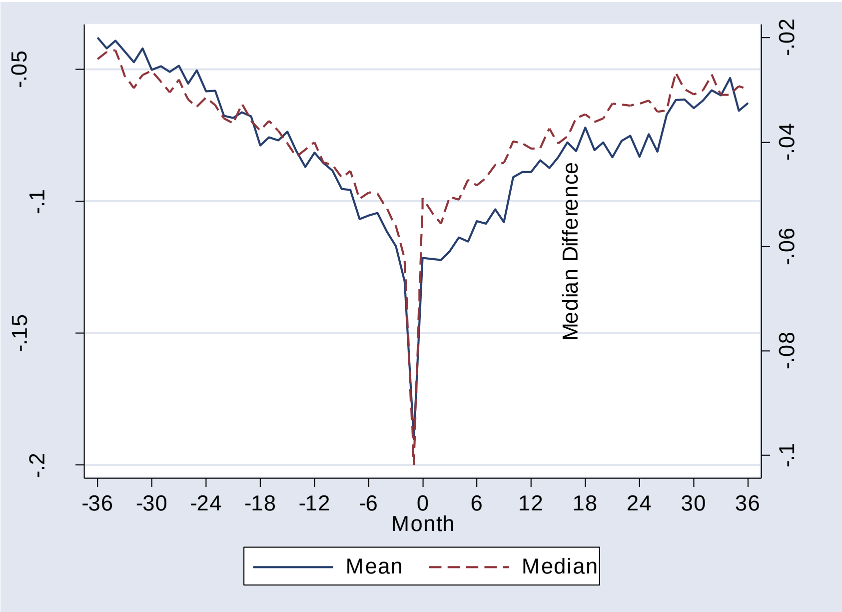

Figure 2
Relative Risk Dynamics: The Bidder Firms with Increasing Relative Risk before M&A

This figure plots the time series of mean and median differences in firm risk between bidders and their industry- and size-matched control firms, for the 36 months before the bid announcement date and the 36 months after the deal effective date. Month 0 starts from the day after the bid announcement and ends on the day before the deal effective date. All other months consist of 21 trading days. Firm risk is the annualized standard deviation of the daily stock returns in the month. At the fiscal year end before bid announcement, each bidder is matched with a Fama-French (1997) 48-industry peer with the closest size. Only bidders with *positive* relative change in firm risk from month –36 to –1 are included. Relative change in firm risk is defined as (bidder risk in month –1 – bidder risk in month –36) – (match firm risk in month –1 – match firm risk in month –36). The sample has 661,021 firm-month observations.

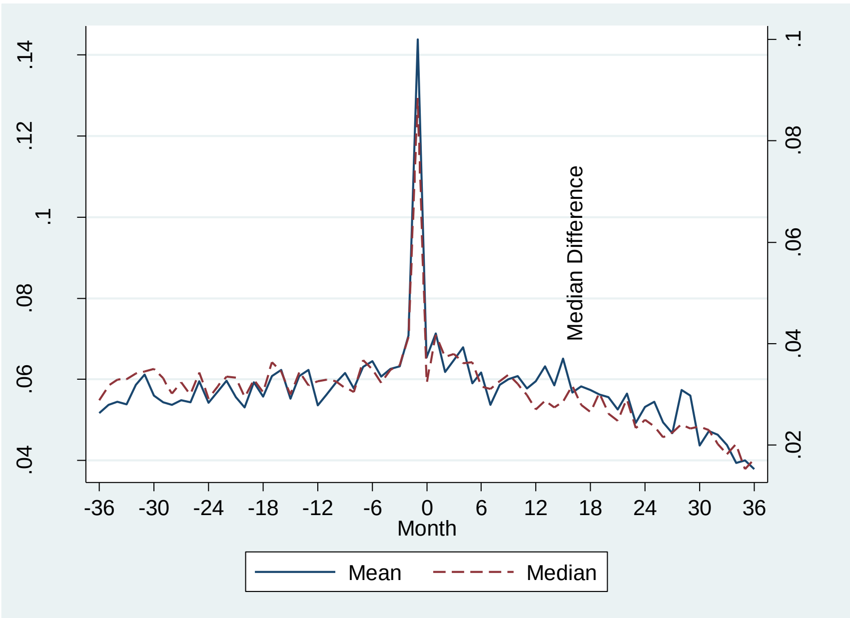

Figure 3
Relative Risk Dynamics: The Target Firms

This figure plots the time series of mean and median differences in firm risk between target firms and their industry- and size-matched control firms, for the 36 months prior to the month of the bid announcement date. Each month consists of 21 trading days. Firm risk is the annualized standard deviation of the daily stock returns in the month. At the fiscal year end before bid announcement, each target firm is matched with a Fama-French (1997) 48-industry peer with the closest size. The sample has 254,536 firm-month observations.

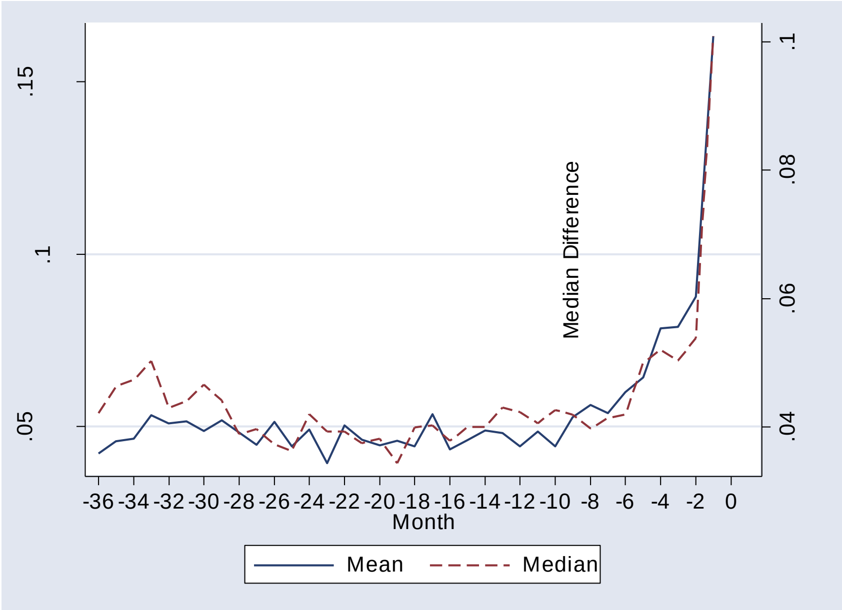

Table 1
Summary Statistics

Our sample consists of completed M&A deals announced over the period 1980-2007. The data are retrieved from the SDC database and have available data from CRSP/Compustat. See the Appendix for definition of the variables. All percentages are in real numbers. All firm characteristics are measured at the fiscal year end prior to the bid announcement date.

Variable	N	Mean	StdDev	5th Percentile	Median	95th Percentile
Bidder CAR3	1093	-0.012	0.057	-0.105	-0.009	0.071
Target CAR3	1091	0.203	0.231	-0.072	0.161	0.619
Relative Size	1093	0.192	0.511	0.002	0.058	0.783
Bidder Risk	1093	0.345	0.209	0.164	0.299	0.665
Target Risk	1093	0.511	0.285	0.202	0.450	1.027
Risk Ratio (Target/Bidder)	1093	1.625	0.920	0.737	1.406	3.120
Return Covariance	1093	0.026	0.056	-0.010	0.012	0.103
Return Correlation	1093	0.138	0.163	-0.061	0.102	0.467
Bidder Sales Growth	1093	0.216	0.493	-0.110	0.124	0.762
Bidder ROA	1093	0.049	0.100	-0.029	0.037	0.183
Bidder Book Leverage	1093	0.204	0.148	0.002	0.181	0.489
Bidder Book Leverage Deviation	957	-0.007	0.125	-0.186	-0.020	0.222
Tender Offer	1093	0.195	0.396	0.000	0.000	1.000
Competing Bids	1093	0.048	0.213	0.000	0.000	0.000
All Cash	1093	0.270	0.444	0.000	0.000	1.000
All Stock	1093	0.381	0.486	0.000	0.000	1.000
Diversifying	1093	0.349	0.477	0.000	0.000	1.000
Bidder Price Runup	1093	0.277	0.453	-0.311	0.219	0.955
Market Price Runup	1093	0.166	0.153	-0.146	0.174	0.378
Bidder Delta	383	2.377	0.159	2.118	2.390	2.597
Bidder Vega	349	2.285	0.164	2.001	2.296	2.520
Bidder Board Size	393	11.598	4.050	6.000	11.000	19.000
Bidder Board Independence	393	0.692	0.162	0.375	0.714	0.900
Bidder CEO is COB	393	0.710	0.454	0.000	1.000	1.000

Table 2
The Correlation Matrix

Our sample consists of completed M&A deals announced over the period 1980-2007. The data are retrieved from the SDC database and have available data from CRSP/Compustat. See the Appendix for definition of the variables. All percentages are in real numbers. All firm characteristics are measured at the fiscal year end prior to the bid announcement date. The corresponding p-value is reported in the brackets below each coefficient.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Relative Size	1.00																		
2	Relative Risk	-0.17	1.00																	
		[0.00]																		
3	Return Correlation * (1-2*Relative Size)	-0.52	-0.01	1.00																
		[0.00]	[0.64]																	
4	Bidder Sales Growth	0.21	-0.08	-0.10	1.00															
		[0.00]	[0.01]	[0.00]																
5	Bidder ROA	-0.07	0.10	0.08	0.21	1.00														
		[0.03]	[0.00]	[0.01]	[0.00]															
6	Bidder Book Leverage	0.09	-0.10	-0.03	0.13	-0.08	1.00													
		[0.00]	[0.00]	[0.26]	[0.00]	[0.01]														
7	Bidder Book Leverage Deviation	0.04	-0.09	-0.05	0.17	-0.17	0.81	1.00												
		[0.18]	[0.00]	[0.11]	[0.00]	[0.00]	[0.00]													
8	Tender Offer	0.00	-0.01	0.01	-0.05	0.12	0.01	-0.10	1.00											
		[0.99]	[0.78]	[0.87]	[0.07]	[0.00]	[0.73]	[0.00]												
9	Competing Bids	0.04	-0.03	-0.04	0.01	-0.02	0.04	-0.02	0.17	1.00										
		[0.19]	[0.28]	[0.21]	[0.83]	[0.50]	[0.15]	[0.52]	[0.00]											
10	All Cash	-0.10	0.18	0.00	-0.09	0.10	-0.06	-0.07	0.39	0.08	1.00									
		[0.00]	[0.00]	[0.88]	[0.00]	[0.00]	[0.03]	[0.02]	[0.00]	[0.01]										
11	All Stock	0.03	-0.05	0.00	0.05	-0.09	-0.09	0.03	-0.36	-0.06	-0.48	1.00								
		[0.39]	[0.09]	[0.95]	[0.10]	[0.00]	[0.00]	[0.38]	[0.00]	[0.05]	[0.00]									
12	Diversifying	-0.03	0.06	0.03	-0.01	0.12	0.06	0.03	0.16	0.00	0.08	-0.09	1.00							
		[0.30]	[0.05]	[0.33]	[0.86]	[0.00]	[0.04]	[0.36]	[0.00]	[0.97]	[0.01]	[0.00]								
13	Bidder Price Runup	0.14	-0.04	-0.06	0.07	0.07	-0.01	0.04	-0.10	-0.06	-0.11	0.14	-0.01	1.00						
		[0.00]	[0.23]	[0.03]	[0.02]	[0.02]	[0.64]	[0.17]	[0.00]	[0.05]	[0.00]	[0.00]	[0.76]							
14	Market Price Runup	0.00	0.03	0.03	-0.04	0.01	0.01	0.03	0.00	-0.03	-0.05	0.09	-0.03	0.32	1.00					
		[0.96]	[0.32]	[0.34]	[0.21]	[0.73]	[0.64]	[0.33]	[1.00]	[0.32]	[0.12]	[0.00]	[0.33]	[0.00]						
15	Bidder Delta	-0.09	0.02	0.09	0.10	0.13	-0.04	-0.04	-0.10	-0.08	0.05	0.05	0.01	0.10	-0.03	1.00				
		[0.08]	[0.71]	[0.06]	[0.05]	[0.01]	[0.46]	[0.43]	[0.05]	[0.11]	[0.31]	[0.31]	[0.79]	[0.06]	[0.58]					
16	Bidder Vega	-0.06	0.04	0.21	0.07	0.13	0.00	-0.04	0.01	0.00	0.18	-0.10	0.04	-0.03	-0.06	0.83	1.00			
		[0.26]	[0.43]	[0.00]	[0.19]	[0.01]	[0.97]	[0.52]	[0.87]	[0.98]	[0.00]	[0.07]	[0.41]	[0.57]	[0.28]	[0.00]				
17	Bidder Board Size	-0.26	0.05	0.23	0.01	-0.14	0.11	0.07	-0.20	-0.04	-0.12	0.18	-0.02	-0.05	0.11	0.16	0.19	1.00		
		[0.00]	[0.30]	[0.00]	[0.92]	[0.01]	[0.03]	[0.18]	[0.00]	[0.42]	[0.01]	[0.00]	[0.63]	[0.32]	[0.03]	[0.01]	[0.00]			
18	Bidder Board Independence	-0.11	0.11	0.17	-0.12	0.00	0.01	0.03	-0.05	-0.19	0.06	-0.13	0.06	0.02	-0.06	-0.10	0.07	0.13	1.00	
		[0.03]	[0.03]	[0.00]	[0.02]	[0.92]	[0.78]	[0.57]	[0.29]	[0.00]	[0.27]	[0.01]	[0.27]	[0.70]	[0.24]	[0.12]	[0.32]	[0.01]		
19	Bidder CEO is COB	-0.02	0.01	0.08	0.04	-0.12	0.09	0.01	0.00	-0.02	-0.06	-0.02	-0.04	-0.02	0.02	0.05	0.14	0.09	0.17	1.00
		[0.71]	[0.81]	[0.13]	[0.39]	[0.02]	[0.09]	[0.80]	[0.95]	[0.74]	[0.20]	[0.65]	[0.42]	[0.69]	[0.67]	[0.39]	[0.04]	[0.07]	[0.00]	

Table 3
Determinants of Relative Size: The Risk Homeostasis Perspective

Our sample consists of completed M&A deals announced over the period 1980-2007. The data are retrieved from the SDC database and have available data from CRSP/Compustat. See the Appendix for definition of the variables. All percentages are in real numbers. All firm characteristics are measured at the fiscal year end prior to the bid announcement date. The corresponding p-value is reported in the brackets below each coefficient. ***, **, and * correspond to statistical significance at the one, five, and ten percent levels, respectively.

Dependent Variable	Relative Size						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Risk Ratio (Target/Bidder)	-0.104***	-0.078***	-0.072***	-0.083***	-0.083***	-0.106***	-0.086***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Return Correlation * (1-2*Relative Size)	-1.655***	-1.561***	-1.556***	-0.613***	-0.626***	-0.750***	-0.670***
	[0.008]	[0.007]	[0.006]	[0.000]	[0.000]	[0.000]	[0.000]
Bidder Sales Growth		0.166	0.356	0.026	0.023	0.063	0.063
		[0.230]	[0.177]	[0.464]	[0.537]	[0.135]	[0.230]
Bidder ROA		-0.317**	-0.279*	-0.353**	-0.429***	-0.126	-0.265
		[0.017]	[0.070]	[0.020]	[0.006]	[0.285]	[0.120]
Bidder Book Leverage		-0.042		0.202***	0.189**	0.227***	0.260***
		[0.669]		[0.009]	[0.023]	[0.006]	[0.004]
Bidder Book Leverage Deviation			-0.097				
			[0.615]				
Tender Offer		0.039	0.063*	-0.015	0.006	-0.026	-0.006
		[0.253]	[0.090]	[0.630]	[0.867]	[0.268]	[0.864]
Competing Bids		0.022	0.009	0.012	0.007	0.023	0.071
		[0.584]	[0.880]	[0.737]	[0.859]	[0.640]	[0.100]
All Cash		-0.071**	-0.074*	-0.122***	-0.138***	-0.102***	-0.125***
		[0.026]	[0.052]	[0.000]	[0.000]	[0.000]	[0.000]
All Stock		0.038	0.039	-0.064**	-0.073**	-0.028	-0.039
		[0.373]	[0.375]	[0.021]	[0.015]	[0.375]	[0.253]
Diversifying		-0.032	-0.044*	-0.015	-0.033	-0.024	-0.004
		[0.135]	[0.085]	[0.541]	[0.196]	[0.345]	[0.885]
Bidder Price Runup		0.119***	0.121**	0.039	0.038	0.053**	0.053*
		[0.004]	[0.012]	[0.236]	[0.274]	[0.036]	[0.098]
Market Price Runup		-0.089	-0.108	-0.027	-0.025	-0.052	0.120

		[0.380]	[0.348]	[0.829]	[0.847]	[0.658]	[0.432]
Bidder Delta				-0.089			0.073
				[0.235]			[0.413]
Bidder Vega					-0.011		
					[0.889]		
Bidder Board Size						-0.001	-0.004
						[0.694]	[0.263]
Bidder Board Independence						0.000	0.068
						[0.996]	[0.427]
Bidder CEO is COB						0.007	-0.027
						[0.741]	[0.354]
Constant	0.344**	0.234**	0.170	0.594***	0.389**	0.291	0.220
	[0.022]	[0.041]	[0.169]	[0.007]	[0.031]	[0.138]	[0.430]
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1093	1093	957	383	349	393	249
Adjusted R2	0.35	0.39	0.40	0.59	0.60	0.56	0.61

Table 4
Determinants of Relative Size: The Risk Aversion Perspective

Our sample consists of completed M&A deals announced over the period 1980-2007. The data are retrieved from the SDC database and have available data from CRSP/Compustat. See the Appendix for definition of the variables. All percentages are in real numbers. All firm characteristics are measured at the fiscal year end prior to the bid announcement date. Panel A presents the test results when the target risk is greater than the bidder risk. Panel B presents the test results when the target risk is smaller than the bidder risk. The corresponding p-value is reported in the brackets below each coefficient. ***, **, and * correspond to statistical significance at the one, five, and ten percent levels, respectively.

Panel A: The target risk is greater than the bidder risk

Dependent Variable	Relative Size						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Risk Ratio (Target/Bidder)	-0.058***	-0.042***	-0.038***	-0.043***	-0.036**	-0.076***	-0.039*
	[0.000]	[0.002]	[0.008]	[0.004]	[0.018]	[0.000]	[0.099]
Return Correlation	0.176***	0.159***	0.166***	0.123*	0.171**	0.162**	0.143*
	[0.001]	[0.001]	[0.002]	[0.073]	[0.043]	[0.016]	[0.058]
Bidder Sales Growth		0.050*	0.086*	0.023	0.012	0.013	0.030
		[0.054]	[0.065]	[0.567]	[0.784]	[0.807]	[0.599]
Bidder ROA		-0.607**	-0.253**	-0.612**	-0.691***	-0.115	-0.431
		[0.025]	[0.013]	[0.018]	[0.009]	[0.517]	[0.129]
Bidder Book Leverage		0.041		0.159*	0.170*	0.270**	0.319**
		[0.624]		[0.074]	[0.089]	[0.028]	[0.011]
Bidder Book Leverage Deviation			0.198*				
			[0.084]				
Tender Offer		-0.025	-0.014	-0.062*	-0.057	-0.061**	-0.017
		[0.207]	[0.552]	[0.063]	[0.102]	[0.042]	[0.675]
Competing Bids		0.032	0.006	-0.006	-0.006	0.012	0.061
		[0.253]	[0.866]	[0.893]	[0.905]	[0.809]	[0.316]
All Cash		-0.115***	-0.127***	-0.133***	-0.141***	-0.105***	-0.160***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
All Stock		-0.041	-0.050*	-0.058*	-0.063*	-0.029	-0.028
		[0.104]	[0.072]	[0.069]	[0.059]	[0.546]	[0.499]
Diversifying		-0.048***	-0.046**	-0.026	-0.031	-0.014	-0.008

		[0.009]	[0.021]	[0.346]	[0.286]	[0.683]	[0.794]
Bidder Price Runup		0.115***	0.079**	0.061	0.050	0.075**	0.058
		[0.004]	[0.014]	[0.124]	[0.238]	[0.032]	[0.178]
Market Price Runup		-0.172*	-0.144	-0.205	-0.220	-0.269*	-0.011
		[0.094]	[0.179]	[0.171]	[0.161]	[0.097]	[0.950]
Bidder Delta				-0.201**			-0.036
				[0.020]			[0.718]
Bidder Vega					-0.240***		
					[0.004]		
Bidder Board Size						-0.006	-0.007
						[0.103]	[0.104]
Bidder Board Independence						-0.140	-0.084
						[0.215]	[0.419]
Bidder CEO is COB						-0.002	-0.028
						[0.932]	[0.464]
Constant	-0.022	-0.011	-0.098	0.873***	0.888***	0.425***	0.746***
	[0.673]	[0.880]	[0.131]	[0.000]	[0.000]	[0.000]	[0.010]
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	879	879	768	308	281	318	199
Adjusted R2	0.18	0.28	0.26	0.35	0.36	0.28	0.30

Panel B: The target risk is smaller than the bidder risk

Dependent Variable	Relative Size						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Risk Ratio (Target/Bidder)	-0.642*	-0.371	-0.333	-0.464	-0.242	-0.230	-0.842
	[0.073]	[0.289]	[0.434]	[0.523]	[0.730]	[0.662]	[0.133]
Return Correlation	0.149	-0.104	-0.129	0.260	0.316	0.355**	0.762*
	[0.483]	[0.682]	[0.647]	[0.482]	[0.397]	[0.045]	[0.078]
Bidder Sales Growth		0.933	1.008	0.066	-0.071	0.149	-0.728
		[0.103]	[0.142]	[0.866]	[0.841]	[0.560]	[0.344]
Bidder ROA		-1.038*	-1.146	0.445	0.516	-0.539	0.890
		[0.086]	[0.154]	[0.552]	[0.553]	[0.388]	[0.306]
Bidder Book Leverage		-1.031*		0.258	0.661	0.323	-1.180
		[0.099]		[0.735]	[0.379]	[0.524]	[0.190]
Bidder Book Leverage Deviation			-0.581				
			[0.443]				
Tender Offer		-0.132	-0.153	0.291	0.061	0.069	0.375

		[0.540]	[0.583]	[0.376]	[0.808]	[0.698]	[0.106]
Competing Bids		0.195	0.345	-0.151	0.118	-0.351	-1.788
		[0.444]	[0.310]	[0.730]	[0.746]	[0.166]	[0.261]
All Cash		0.118	0.103	0.006	-0.017	0.014	-0.550
		[0.403]	[0.493]	[0.965]	[0.893]	[0.914]	[0.111]
All Stock		0.181	0.167	-0.166	-0.176	-0.096	-0.797**
		[0.227]	[0.354]	[0.482]	[0.438]	[0.518]	[0.040]
Diversifying		-0.485**	-0.549**	-0.164	-0.112	-0.152	-0.167
		[0.030]	[0.023]	[0.236]	[0.280]	[0.170]	[0.301]
Bidder Price Runup		0.068	0.184	0.104	-0.026	-0.158	0.262
		[0.481]	[0.182]	[0.762]	[0.935]	[0.512]	[0.176]
Market Price Runup		-0.074	0.066	0.241	0.519	0.595	-0.186
		[0.889]	[0.907]	[0.656]	[0.295]	[0.242]	[0.725]
Bidder Delta				-0.145			1.246**
				[0.773]			[0.038]
Bidder Vega					-0.101		
					[0.801]		
Bidder Board Size						-0.008	0.010
						[0.573]	[0.536]
Bidder Board Independence						-0.020	-1.697**
						[0.967]	[0.022]
Bidder CEO is COB						-0.044	-0.223*
						[0.599]	[0.078]
Constant	0.947***	0.333	-2.473	0.818	0.716	0.570	1.885
	[0.000]	[0.602]	[0.269]	[0.628]	[0.596]	[0.357]	[0.241]
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	214	214	189	75	68	75	50
Adjusted R2	0.22	0.40	0.39	0.35	0.51	0.32	0.87

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